

Title (en)
RESIN POWDER FOR SOLID FREEFORM FABRICATION, DEVICE FOR SOLID FREEFORM FABRICATION OBJECT, AND METHOD OF MANUFACTURING SOLID FREEFORM FABRICATION OBJECT

Title (de)
HARZPULVER ZUR FERTIGUNG VON FESTEN FREIFORMEN, VORRICHTUNG ZUR FERTIGUNG VON FESTEN FREIFORMOBJEKTEN UND VERFAHREN ZUR FERTIGUNG VON FESTEN FREIFORMOBJEKTEN

Title (fr)
POUDRE DE RÉSINE POUR LA FABRICATION DE FORME LIBRE SOLIDE, DISPOSITIF POUR UN OBJET DE FABRICATION DE FORME LIBRE SOLIDE ET PROCÉDÉ DE FABRICATION D'UN OBJET DE FABRICATION DE FORME LIBRE SOLIDE

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Application
EP 20177083 A 20170721

Priority

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- JP 2017049036 A 20170314
- JP 2017111488 A 20170606
- JP 2017138268 A 20170714
- EP 17182489 A 20170721

Abstract (en)
[origin: EP3272788A1] A resin powder for solid freeform fabrication has a 50 percent cumulative volume particle diameter of from 5 to 100 µm and a ratio (Mv/Mn) of a volume average particle diameter (Mv) to the number average particle diameter (Mn) of 2.50 or less and satisfies at least one of the following conditions (1) to (3): (1): Tmf1 > Tmf2 and (Tmf1 - Tmf2) #¥ 3 degrees C, both Tmf1 and Tmf2 are measured in differential scanning calorimetry measuring according to ISO 3146, (2): Cd1 > Cd2 and (Cd1 - Cd2) #¥ 3 percent, both Cd1 and Cd2 are measured in differential scanning calorimetry measuring according to ISO 3146, and (3): C × 1 > C × 2 and (C × 1 - C × 2) #¥ 3 percent.

IPC 8 full level
B33Y 70/00 (2020.01)

CPC (source: CN EP US)
B29B 9/12 (2013.01 - EP); **B29B 9/16** (2013.01 - EP); **B29C 64/153** (2017.07 - EP US); **B33Y 10/00** (2014.12 - CN); **B33Y 70/00** (2014.12 - US); **B33Y 70/10** (2020.01 - CN EP US); **C08F 110/06** (2013.01 - US); **C08G 8/02** (2013.01 - US); **C08G 63/183** (2013.01 - US); **C08G 67/00** (2013.01 - US); **C08G 69/26** (2013.01 - US); **C08J 3/12** (2013.01 - EP US); **C08K 3/016** (2017.12 - EP US); **C08K 3/08** (2013.01 - CN); **C08K 5/0066** (2013.01 - US); **C08K 7/06** (2013.01 - CN); **C08K 7/14** (2013.01 - CN); **C08K 7/18** (2013.01 - CN); **C08L 23/12** (2013.01 - CN); **C08L 59/00** (2013.01 - CN); **C08L 61/16** (2013.01 - CN); **C08L 67/02** (2013.01 - CN); **C08L 77/06** (2013.01 - CN); **B29B 2009/125** (2013.01 - EP); **B29K 2101/12** (2013.01 - US); **B29K 2105/251** (2013.01 - US); **B29K 2995/0041** (2013.01 - US); **B33Y 10/00** (2014.12 - US); **C08J 2361/00** (2013.01 - EP US); **C08J 2361/16** (2013.01 - EP US); **C08J 2367/02** (2013.01 - EP US); **C08J 2367/04** (2013.01 - EP US); **C08J 2377/02** (2013.01 - EP US); **C08J 2377/08** (2013.01 - EP US); **C08J 2377/10** (2013.01 - EP US); **C08K 2003/0812** (2013.01 - CN); **C08L 2201/02** (2013.01 - CN); **Y02P 10/25** (2015.11 - EP)

Citation (opposition)
Opponent : Arkema France

- JP 2016144862 A 20160812 - MAKITA CORP
- JP 2017049036 A 20170309 - MITUTOYO CORP
- JP 2017111488 A 20170622 - FUJI XEROX CO LTD
- JP 2017138268 A 20170810 - DENSO CORP
- WO 2013090174 A1 20130620 - ADVANCED LASER MATERIALS LLC [US]
- JP 2017043654 A 20170302 - TORAY INDUSTRIES
- WO 2016104140 A1 20160630 - TORAY INDUSTRIES [JP]
- EP 3239214 A1 20171101 - TORAY INDUSTRIES [JP]
- US 2008258330 A1 20081023 - MULLER FRANK [DE], et al
- US 2013323416 A1 20131205 - BERTELO CHRISTOPHER A [US], et al
- EP 1413595 A1 20040428 - ATOFINA [FR]
- US 2009236775 A1 20090924 - MONSHEIMER SYLVIA [DE], et al
- US 2008166496 A1 20080710 - MONSHEIMER SYLVIA [DE], et al
- US 7794647 B1 20100914 - DECKARD CARL [US]
- EP 2177557 A1 20100421 - TECHNO POLYMER CO LTD [JP], et al
- EP 2985269 A1 20160217 - RICOH CO LTD [JP]
- US 2015336292 A1 20151126 - MIKULAK JAMES [US], et al
- WO 2016084928 A1 20160602 - CANON KK [JP]
- US 2017260359 A1 20170914 - HANYU YUKIO [JP], et al
- US 5527877 A 19960618 - DICKENS JR ELMER D [US], et al
- US 2006246287 A1 20061102 - GERSCH MANDY [DE], et al
- US 2011143108 A1 20110616 - FRUTH CARL JOHANNES [DE], et al
- SCHMID ET AL.: "Materials perspective of polymers for additive manufacturing with selective laser sintering", J. MATER. RES., vol. 29, no. 17, 2014, pages 1824 - 1832, XP055906930, DOI: 10.1557/jmr.2014.138
- STÉPHANE DUPIN: "Étude fondamentale de la transformation du polyamide 12 par frittage laser : mécanismes physico-chimiques et relations microstructures/propriétés", LABORATOIRE DE RECHERCHE INGÉNIERIE DES MATÉRIAUX POLYMÈRES (IMP), UMR 5223, INSA DE LYON, BÂTIMENT JULES VERNE, 3ÈME ÉTAGE 17 AVENUE JEAN CAPELLE 69621 VILLEURBANNE CEDEX, FRANCE, 5 July 2012 (2012-07-05), Laboratoire de recherche Ingénierie des Matériaux Polymères (IMP), UMR 5223, INSA de Lyon, Bâtiment Jules Verne, 3ème étage 17 avenue Jean Capelle 69621 VILLEURBANNE CEDEX, France , XP055114943, Retrieved from the Internet <URL:http://theses.insa-lyon.fr/publication/2012ISAL0062/these.pdf> [retrieved on 20140423]
- DUMOULIN E.: "Fabrication additives de pieces en polymers thermoplastiques hautes performances et en polyamide 12 par le procede de frittage selectif par laser", THESIS, 1 January 2013 (2013-01-01), pages 1 - 263, XP055895104, [retrieved on 20220224]
- BOURELL ET AL.: "Performance limitations in polymer laser sintering", PHYSICS PROCEDIA, vol. 56, 2014, pages 147 - 156, XP029053232, DOI: 10.1016/j.phpro.2014.08.157

- GARDNER ET AL.: "Structure, crystallization and morphology of poly(aryl ether ketone ketone)", POLYMER, vol. 33, no. 12, 1992, pages 2483 - 2495, XP024204444, DOI: 10.1016/0032-3861(92)91128-O
- GHITA ET AL.: "Physico-chemical behaviour of Poly (Ether Ketone) (PEK) in High Temperature Laser Sintering (HT-LS)", J. MATER. PROC. TECHNOL., vol. 214, 2014, pages 969 - 978, XP028669844, DOI: 10.1016/j.jmatprotec.2013.11.007
- VERBELEN ET AL.: "Characterization of polyamide powders for détermination of laser sintering processability", EUR. POL. J., vol. 75, 2016, pages 163 - 174, XP029398871, DOI: 10.1016/j.eurpolymj.2015.12.014
- "Differential Scanning Calorimetry (DSC), A Beginner's Guide", 1 January 2010, PERKIN ELMER, INC., article ANONYMOUS: "Frequently asked questions", pages: 1 - 16, XP093020731
- SYLVIE TENCE-GIRAULT ET AL.: "Simultaneous SAXS-WAXS Experiments on Semi-Crystalline Polymers: Example of PA11 and Its Brill Transition", CRYSTALS, vol. 9, no. 271, 1 January 2019 (2019-01-01), pages 1 - 17, XP055796987
- TAKEDA KAZUSADA: "EXHIBIT A-3A D22a, Certificates of Experimental Results ", SOCIÉTÉ TORAY INDUSTRIES INC., 25 March 2019 (2019-03-25), pages 1 - 14, XP093020738
- KITAMURA TETSU: "EXHIBIT A-5A, Certificates of Experimental Results", SOCIÉTÉ TORAY INDUSTRIES INC., 25 October 2019 (2019-10-25), pages 1 - 8, XP093020743
- "Malvern Instruments Ltd. ", 11 August 2008, article ANONYMOUS: "Morphologi GB User manual", pages: 1 - 40, XP093020745
- FULCHER BEN, LEIGH DAVID K: "EFFECT OF SEGREGATED FIRST AND SECOND MELT POINT ON LASER SINTERED PART QUALITY AND PROCESSING", HARVEST TECHNOLOGIES, 1 January 2012 (2012-01-01), pages 1 - 9, XP093020748
- SCHMID MANFRED, WEGENER KONRAD: "Thermal and molecular properties of polymer powders for Selective Laser Sintering (SLS)", AIP CONFERENCE PROCEEDINGS, AMERICAN INSTITUTE OF PHYSICS, NEW YORK, US, vol. 1779, 1 January 2016 (2016-01-01), NEW YORK, US , pages 100003, XP093012147, ISSN: 0094-243X, DOI: 10.1063/1.4965571

Opponent : Evonik Operations GmbH

- EP 3750943 A1 20201216 - RICOH CO LTD [JP]
- EP 3272788 A1 20180124 - RICOH CO LTD [JP]
- EP 3272788 B1 20200708 - RICOH CO LTD [JP]
- JP 2015500375 A 20150105
- JP 2017043654 A 20170302 - TORAY INDUSTRIES
- WO 2016104140 A1 20160630 - TORAY INDUSTRIES [JP]
- US 2016038633 A1 20160211 - WATANABE MASAKI [JP]
- US 5527877 A 19960618 - DICKENS JR ELMER D [US], et al
- US 2006246287 A1 20061102 - GERSCH MANDY [DE], et al
- WO 2013138204 A1 20130919 - MIKULAK JAMES [US], et al
- WO 2013090174 A1 20130620 - ADVANCED LASER MATERIALS LLC [US]
- WO 2016101942 A1 20160630 - VOXELJET AG [DE]
- WO 2007048536 A1 20070503 - POLIMERI EUROPA SPA [IT], et al
- WO 2009135521 A2 20091112 - FIT FRUTH INNOVATIVE TECHNOLOG [DE], et al
- US 7794647 B1 20100914 - DECKARD CARL [US]
- US 2834053 A 19580513 - FRANK BILANIN, et al
- EP 2177557 A1 20100421 - TECHNO POLYMER CO LTD [JP], et al
- WO 2008057844 A1 20080515 - VALSPAR SOURCING INC [US], et al
- BEN FULCHER., DAVID K. LEIGH: "EFFECT OF SEGREGATED FIRST AND SECOND MELT POINT ON LASER SINTERED PART QUALITY AND PROCESSING", HARVEST TECHNOLOGIES, 1 January 2012 (2012-01-01), pages 556 - 564, XP055797001
- ANONYMOUS: "Kunststoffe - Bestimmung des Schmelzverhaltens (Schmelztemperatur oder Schmelzbereich) von teilkristallinen Polymeren im Kapillarrohr- und Polarisationsmikroskopverfahren (ISO 3146:2000)", DIE EUROPÄISCHE NORM EN ISO 3146 : 2000, 1 June 2000 (2000-06-01), pages 1 - 8, XP093022403
- ANONYMOUS: "A basic guide to particle characterization", MALVERN INSTRUMENTS LIMITED, 1 January 2015 (2015-01-01), pages 1 - 24, XP055701324, [retrieved on 20200604]
- SCHMID, M. ET AL.: "Additive Manufacturing: Polymers applicable for Laser Sintering (LS)", PROCEDIA ENGINEERING, vol. 149, 2016, pages 457 - 464, XP029638044, DOI: 10.1016/j.proeng.2016.06.692
- SCHMID, M. ET AL.: "Materials perspective of polymers for additive manufacturing with selective laser sintering", JOURNAL OF MATERIALS RESEARCH, vol. 29, no. 17, 2014, XP055906930, DOI: 10.1557/jmr.2014.138
- DATASHEET OF VESTOSINT
- A. SOMMEREYNS ET AL: "Evaluation of essential powder properties through complementary particle size analysis methods for laser powder bed fusion of polymers", PROCEDIA CIRP, vol. 94, 1 January 2020 (2020-01-01), pages 116 - 121, XP055797027
- DSC MEASUREMENT OF VESTOSINT®
- BERRETTA S. ET AL: "Morphology of polymeric powders in Laser Sintering (LS): From Polyamide to new PEEK powders", EUROPEAN POLYMER JOURNAL, PERGAMON PRESS LTD OXFORD, GB, vol. 59, 12 August 2014 (2014-08-12), GB , pages 218 - 229, XP029056723, ISSN: 0014-3057, DOI: 10.1016/j.eurpolymj.2014.08.004
- MANFRED SCHMID ET AL: "Influence of the Origin of Polyamide 12 Powder on the Laser Sintering Process and Laser Sintered Parts", APPLIED SCIENCES, vol. 7, no. 462, 1 January 2017 (2017-01-01), pages 1 - 15, XP055797006
- ANONYMOUS: "ORGASOL Polyamide Powders", INTERNET ARTICLE, pages 1 - 3, XP002528388, Retrieved from the Internet <URL:http://www.stobec.com/docs/DataSheet/7378.pdf> [retrieved on 20090514]
- ORGASOL, 2003
- WULFHORST J.: "Forschungsbericht RWTH Aachen", FORSCHUNGSBERICHT RWTH AACHEN, 1 January 2011 (2011-01-01), pages 1 - 121, XP055895046, [retrieved on 20220224]
- WULFHORST J., ET AL.: "Substitution of Powders by ultra short cut fibers for selective laser sintering (SLS)", AUTEX 2011 CONFERENCE 8-10TH JUNE 2011, MULHOUSE, FRANCE, 10 June 2011 (2011-06-10), Mulhouse, France, pages 13 - 18, XP055862075, [retrieved on 20211116]

Cited by

US11491713B2; US11926931B2; EP3616869B1; EP3272788B1; EP3750943B1; EP3272787B1

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